

U.S. Application No. 10/752,642
Reply to Office Action mailed May 17, 2006

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REMARKS/ARGUMENTS

In light of the above amendments and following remarks, reconsideration and allowance of this application are respectfully requested.

I. STATUS OF THE CLAIMS AND FORMAL MATTERS

Claims 1-14 are pending in this application. Claims 7-10, 13 and 14 are allowed; claim 4 is objected to; and claims 1-3, 5, 6, 11 and 12 are rejected in the Office Action mailed on May 17, 2006.

Initially, the Examiner is thanked for allowing claims 7-10, 13 and 14 and indicating that claim 4 contains allowable subject matter.

II. THE REJECTIONS UNDER 35 U.S.C. § 102(e)

In the Office Action, claims 1, 2, 3, 5, 6, 11 and 12 are rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent Application Publication No. 2002/0167091 to Iwasaki et al. ("Iwasaki"). The rejections are traversed for at least the following reasons.

As recited in claim 1 of the instant application, one embodiment of the instant invention is directed to a semiconductor device having a multilayer structure comprising:

at least two wiring layers; and
a via contact formed between the at least two layers and made of a metal wiring material which is the same as that of the at least two wiring layers,
wherein the metal wiring material of the via contact contains an additive which is not contained in the metal wiring materials of the at least two wiring layers.

On page 2 of the Office Action, the Examiner alleges that "Iwasaki (e.g., Fig. 1) discloses a semiconductor device, comprising: at least two wiring layers (19, 15); a via contact (17) formed between the at least two layers and made of a metal wiring material (aluminum plus copper) which is the same as that of the at least two wiring layers, wherein the metal wiring

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material of the via contact contains an additive (copper and nickel or silicon, page 2, paragraph [0027] which is not contained in the metal wiring materials of the at least two wiring layers." Applicants' attorneys respectfully submit that this characterization of Iwasaki is incorrect.

The Examiner identifies films 19 and 15 of Iwasaki as corresponding to the at least two wiring layers of claim 1 of the instant application. The Examiner also identifies film 17 of Iwasaki as corresponding to the via contact of claim 1. These identifications, however, are incorrect. Instead, Applicants' attorneys respectfully submit that films 17 and 23 of Iwasaki correspond to the at least two wiring layers of claim 1, and film 20 of Iwasaki corresponds to the via contact of claim 1. In support, reference is made to lines 39-42 of paragraph [0026] that state, "[o]n the first layered interconnection [17], plugs each comprising a main conductive film 20 ... are formed in contact holes formed in insulating film 21." Regarding the phrase "first layered interconnection [17]", please note that lines 27-29 of paragraph [0026] further state, "the first layered interconnection comprising a main conductive film 17." Also, reference is made to the same paragraph [0026], lines 41-43, which states, "[t]o these plugs is connected the second layered interconnection which comprises a main conductive film 23."

Based on these disclosure in Iwasaki, contrary to the Examiner's identifications of the at least two wiring layers and the via contact of Iwasaki, Applicants' attorneys respectfully submit that films 17 and 23 of Iwasaki correspond to the at least wiring layers of claim 1, and film 20 of Iwasaki corresponds to the via contact of claim 1. Please note that the words "plug" and "via contact" are used interchangeably and have the same meaning in this field of art, and formed in a hole also means a "contact hole" or "via hole." In this regard, please see paragraph [0026] of Iwasaki, lines 39-41, which states, "plugs each comprising a main conductive film 20 coated

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with an adjacent conductive film 19 are formed in contact holes." Therefore, this description shows that the words "plug" and "via contact" are used to mean the same thing.

Accordingly, the description in paragraph [0027] of Iwasaki that the Examiner relies on, which includes, "[t]he materials of the main conductive film 17 and the main conductive film 23 respectively provided in the first and second layered interconnections are, for example, aluminum, in which copper is added ...," does not teach that the metal wiring material of the via contact (20) contains an additive which is not contained in the metal wiring materials of the at least two wiring films (17 and 23). Consequently, the Examiner's assertion that Iwasaki discloses a semiconductor device "wherein the metal wiring material of the via contact contains an additive (copper and nickel or silicon, page 2, paragraph [0027] which is not contained in the metal wiring materials of the at least two wiring layers" is incorrect. Hence, independent claim 1 and claims 2-4 that depend from claim 1 are allowable over Iwasaki.

As recited in claim 5 of the instant application, another embodiment of the instant invention is directed to a semiconductor device having a multilayer structure comprising:

- at least two wiring layers; and
- a via contact formed between the at least two layers and made of a metal wiring material which is the same as that of the at least two wiring layers,
- wherein metal wiring materials of the at least two wiring layers contain at least one additive, and
- a metal wiring material of the via contact contains at least two additives which include an additive which is the same as that contained in the metal wiring materials of the at least two wiring layers and an additive which is not contained in the metal wiring materials of the at least two wiring layers.

On page 3 of the Office Action, the Examiner asserts that

Iwasaki (e.g., Fig. 1) discloses a semiconductor device, comprising: at least two wiring layers (19, 15); a via contact (17) formed between the at least two layers and made of a metal wiring material (aluminum plus

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copper) which is the same as that of the at least two wiring layers, wherein metal wiring materials of the at least two wiring layers contain at least one additive, and a metal wiring material of the via contact contains at least two additives which include an additive which is the same (copper) as that contained in the metal wiring materials of the at least two wiring layers and the at least two wiring layers and [sic] an additive which is not contained in the metal wiring materials of the at least two wiring layers (see page 4, last 9 lines of paragraph [0037]).

Firstly, as discussed above for claim 1, the Examiner's identification of the at least two wiring layers and the via contact is incorrect. Instead, the at least two wiring layers correctly correspond to layers 17 and 23, and the via contact corresponds to layer 20.

Secondly, the Examiner's assertion that Iwasaki discloses a semiconductor device comprising a via contact made of a metal wiring material, wherein "a metal wiring material of the via contact contains at least two additives which include an additive which is the same (copper) as that contained in the metal wiring materials of the at least two wiring layers and the at least two wiring layers (sic) and an additive which is not contained in the metal wiring materials of the at least two wiring layers" is incorrect. Paragraph [0037] of Iwasaki states,

[a]s regards the main conductive film of the plugs, aluminum in which copper and nickel are added or in which copper and silicon are added may be used, or another material such as, for example, tungsten or silicon may be used. Further, without using the copper-and-nickel-added aluminum or the copper-and-silicon-added aluminum regarding the whole of the film for forming the interconnection, a part of the whole film may be formed by use of one of these Al alloys.

This paragraph teaches that aluminum in which copper and nickel are added or in which copper and silicon are added, may be used as the main conductive film of the plugs. This paragraph also teaches that aluminum in which copper and nickel are added or in which copper and silicon are added may be used as the main conductive film of at least a portion of the interconnection. Therefore, this paragraph teaches that the same additives may be added in the

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materials of the plug 20 and the interconnections 17 and 23. Consequently, Iwasaki fails to teach "a metal wiring material of the via contact [that] contains at least two additives which include an additive which is the same as that contained in the metal wiring materials of the at least two wiring layers and an additive which is not contained in the metal wiring materials of the at least two wiring layers" as required by claim 5. Therefore, independent claim 5 and claim 6 that depends from claim 5 are allowable over Iwasaki.

Lastly, as recited in claim 11 of the instant application, another embodiment of the instant invention is directed to a semiconductor device comprising:

- a first metal wiring layer made of a first wiring material, formed in a first wiring groove formed in a first insulating film on a semiconductor substrate;
- a second insulating film on the first insulating film having the first wiring layer embedded therein;
- a via contact embedded in a via hole formed in the second insulating film, the via contact being made of the same wiring material as the first wiring material, which contain an additive which is not contained in the first wiring material of the first wiring layer;
- a third insulating film on the second insulating film having the via contact formed therein; and
- a second metal wiring layer embedded in a second wiring groove formed in the third insulating film, the second metal wiring layer being made of the same metal wiring material as the metal wiring material of the first metal wiring layer.

On page 3 of the Office Action, the Examiner alleges that

Iwasaki discloses a semiconductor device, comprising: a first metal wiring layer (15) made of a first wiring material, formed in a first wiring groove formed in a first insulating film (13) on a semiconductor substrate (1); a second insulating film (18) on the first insulating film having the first wiring layer embedded therein; a via contact (17) embedded in a via hole formed in the second insulating film, the via contact being made of the same wiring material as the first wiring material, which contain an additive (Ni, Si) which is not contained in the first wiring material of the first wiring layer; a third insulating film (21) on the second insulating film having the via contact formed therein; and a second metal wiring layer (19) embedded in a second

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wiring groove formed in the third insulating film, the second metal wiring layer being made of the same metal wiring material as the metal wiring material of the first metal wiring layer.

Firstly, as discussed above for claim 1, the Examiner's identification of the first and second wiring layers (which correspond to the at least two wiring layers in claim 1) and the via contact is incorrect. Instead, the at least two wiring layers correctly correspond to layers 17 and 23, and the via contact corresponds to layer 20.

Secondly, the Examiner's assertion that Iwasaki discloses a semiconductor device comprising "a via contact (17) embedded in a via hole formed in the second insulating film, the via contact being made of the same wiring material as the first wiring material, which contains an additive (Ni or Si) which is not contained in the first metal wiring material of the first wiring layer" is incorrect. As recited in paragraph [0027] of Iwasaki, "[t]he materials of the main conductive film 17 and the main conductive film 23 respectively provided in the first and second layered interconnections are, for example, aluminum, in which copper is added" As discussed above for claim 1, this paragraph does not teach that the metal wiring material of the via contact (20) contains an additive which is not contained in the wiring material of the first wiring layer (17). Therefore, the Examiner's assertion that Iwasaki discloses a semiconductor device comprising "a second metal wiring layer (19) embedded in a second wiring groove formed in the third insulating film, the second metal wiring layer being made of the same metal wiring material as the metal wiring material of the first metal wiring layer" is incorrect.

Thirdly, paragraph [0037] of Iwasaki states,

[a]s regards the main conductive film of the plugs, aluminum in which copper and nickel are added or in which copper and silicon are added may be used, or another material such as, for example, tungsten or silicon may be used. Further, without using the copper-and-nickel-added aluminum or the copper-and-silicon-added aluminum regarding

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the whole of the film for forming the interconnection, a part of the whole film may be formed by use of one of these Al alloys.

This paragraph, however, teaches that aluminum in which copper and nickel are added or in which copper and silicon are added may be used as the main conductive film of at least a portion of the interconnection. Consequently, this paragraph teaches that the same additives may be added in the materials of the plug 20 and the interconnections 17 and 23. Therefore, Iwasaki fails to teach "a via contact embedded in a via hole formed in the second insulating film, the via contact being made of the same wiring material as the first wiring material, which contain an additive which is not contained in the first wiring material of the first wiring layer" as required by claim 11. Accordingly, independent claim 11 and claim 12 that depends from claim 11 are allowable over Iwasaki.

For at least the foregoing reasons, Applicants' attorneys respectfully submit that independent claims 1, 6 and 11 patentably distinguish over the relied upon portions of Iwasaki and are therefore allowable. Further, claims 2-4 that depend from claim 1, claim 6 that depends from claim 5 and claim 12 that depends from claim 11 are allowable as well. Consequently, reconsideration and withdrawal of the Section 102 rejections are earnestly requested.

Statements appearing above with respect to the disclosures in the cited references represent the present opinions of the Applicant's undersigned attorney and, in the event that the Examiner disagrees with any such opinions, it is respectfully requested that the Examiner specifically indicate those portions of the respective reference providing the basis for a contrary view.

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CONCLUSION

In view of the foregoing, it is believed that all of the claims in this application are patentable over the prior art, and an early and favorable consideration thereof is solicited.

Please charge any fees incurred by reason of this response and not paid herewith to
Deposit Account No. 50-0320.

Respectfully submitted,
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